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Analysis

Energy consumption in service industries: Challenging the myth of non-materiality

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ABSTRACT

This paper addresses the issue of energy consumption in service industries. Official energy statistics show that the amount of energy consumed in service industries is quite small, and this is explained in the theoretical literature by the presumed intangibility of services. Our hypothesis, however, is that the energy consumed by services has been underestimated. After identifying and analyzing the full range of sources of energy consumption in service industries, we show that official energy statistics account for only a part of this consumption. Our work is based on a thorough rereading of the economics literature on services (especially concerning the definition of services and the specificities of the service provision process), done in light of our knowledge about energy consumption. Eventually, using the 2007 French national transportation and travel survey, we estimate one of the overlooked sources of energy consumption, the one pertaining to mobility.

1. Introduction

In economic theory, services are often described as "non-material", "immaterial" or "intangible" (Say, 1972; Sismondi, 1971; Smith, 1970). This non-materiality would explain their having smaller negative impact on the environment and lower energy consumption than does industry. Inasmuch as growth in recent decades has been largely driven by the development of services, a number of studies, particularly in the early 1990s, have argued that we are trending towards an ever more non-material society creating less environmental wear (Arrow et al., 1995; Bernardini and Galli, 1993; Ettighoffer, 1992; Romm et al., 1999). Against such conclusions, however, we would note that the most service-intensive countries are as a whole greater consumers of energy, with a larger ecological footprint, than countries whose service sector is less developed (Gadrey, 2010). Given the vital stakes involved in bringing energy demand under control, primarily due to the threats of diminished fossil resources and climate change, it is important to come down on one side or the other of these opposing arguments and identify the conditions that might foster sustainability in the service economies. In this paper we consider the question of the non-materiality of services from the viewpoint of their energy consumption. The following are our hypotheses: (1) service activities are not as non-material as has been imagined, (2) they consume non-trivial amounts of energy, which are underestimated in the official statistics and (3) mobility related to service operations represents an important amount of energy consumption that is not accounted for in the official statistics. To address this question it is necessary to understand the forms which energy demand takes in the service sector. There are rather few theoretical studies concerned with energy consumption in the services sector. Our analyses are based on a review, guided by the question of energy consumption, of the theoretical literature on services which is concerned with their definition and an analytical breakdown of how they are provided. We also make use of the 2007 French transportation survey to estimate the energy consumption for transportation activities related to the consumption and production of services. The first part of the paper is devoted to a discussion of what might be called the myth of the non-materiality of services. In the second part we attempt, on the basis of a theoretical breakdown of the provision of services, to identify all the sources of direct energy consumption by services. We show that the official energy statistics account for only a part of energy consumption. On the basis of a systemic perspective of the service activity, we broaden our view so as to identify energy consumption indirectly related to the provision of services. The final part of the paper is devoted to an attempt to estimate the magnitude of one of the neglected sources of energy consumption, the one pertaining to mobility.

2. The Myth of the Non-materiality of Services

One can trace the origin of the concept of *non-materiality* (or *intangibility*) of services back to Adam Smith and his analysis of the accumulation of capital. In his book *The Wealth of Nations*, Smith (1970) distinguishes two types of economic activity: productive work, like that of the worker who adds value to the materials he handles and transforms, and unproductive work which adds no value.

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Among the unproductive activities Smith identifies the activities we today term services.[1] Although the adjective "non-material" is never directly used, the idea of non-materiality is implicit, as the following quotes illustrate: "the [unproductive] labour does not fix or realize itself in any permanent subject, or vendible commodity, which endures after that labour is past, or for which an equal quantity of labour could afterwards be procured" (Smith, 1970, p. 430) "the work of all [the services] perishes in the very instant of its production" (Smith, 1970, p. 431).

In a discussion of the accumulation of capital, Say (1972) questions the term *unproductive*. According to him, although they produce no value, the services are useful and sources of visible outcomes (e.g. the cure produced by a physician). He therefore introduces the term *immaterial*.

Most of his contemporaries have adopted this term, which became the main characteristic used to describe service activities. For 19th century economists the non-materiality of services meant that the service is consumed and produced simultaneously (Say, 1972), that its outcome does not take a material form, that it cannot be accumulated (Sismondi, 1971) and that it does not produce an exchangeable value.[2]

In the 20th century, when the notion of a tertiary sector first appeared, the adjective *non-material* was applied to it as well. The idea of non-materiality of services was then fleshed out by an assumed lesser usage of capital goods (i.e. lower capital intensity). Thus Clark (1960) observed that most service businesses require far less in the way of capital goods than industry or agriculture.

A number of contemporary studies, however, question the notion that non-materiality fairly characterizes services (Delaunay and Gadrey, 1987; Fuchs, 1968; Gadrey, 2003; Illeris, 1989). Transportation and communications services are among the most capital intensive. They require the use of a great deal of equipment. Furthermore, certain services are performed upon media which are tangible goods (books and newspapers publishing, sculpture, painting, etc.[3]), while other services repair, maintain or transform tangible goods (repair and maintenance services, but also restaurants and other food services), or move them about (transportation, wholesale and retail trade, etc.) or make them available to users (rental services). In contemporary economies, the invasiveness of information and communications technologies also casts doubt on this notion of non-materiality. All service businesses today make use of information and communications technologies (ICTs), which in some cases give a physical form to the service (the recording of a lecture, for example).

Be that as it may, the notion of the non-materiality of services remains a chief feature by which service operations can be distinguished from other economic activities. In their attempts to propose a *positive* definition of services,[4] Hill (1977)) and Gadrey (2003) preserve non-materiality as an essential characteristic of services. Thus Hill (1977) defines services as a *change in the condition* of a person or a good,[5] and Gadrey (2003) stresses that a service business does not result "in the production of a good that can circulate economically apart from its medium" (Gadrey, 2003, p. 19).

The (non)-materiality issue is still at the heart of a more recent debate between Gadrey (2000) and Hill (1999).[6] It is also at the heart of the *service-dominant logic* in marketing (Lusch and Vargo, 2006) or the emerging *service-science* field (Maglio et al., 2010).

Other arguments can be brought in, at the macro level, to support the continued notion of non-materiality as a relevant analytic category to describe services. Such is the case, for instance, with the theory of the post-industrial society dominated by service activities (Bell, 1976) with the so-called knowledge based economy (Aoyama and Castells, 2002; Foray, 2000; Stehr, 2007), or with the *new* or *net economy* (Gadrey, 2002).

Against the current background of diminishing natural resources and environmental deterioration, the notion of non-materiality of services has often been taken to mean that services have a low impact on the environment and in particular that they consume less energy (Illeris, 2007; OECD, 2000; Rifkin, 2000). This idea is corroborated by a number of empirical observations. In France's energy accounting, in 2006 services represented only 14% of total energy consumption (Mairet, 2009) whereas in the same year they represented 75.1% of value added and 74.7% of total domestic employment (INSEE[7] national accounts). However it should be noticed that statistics about energy use are not directly comparable to statistics of national income accounting because the breakdown of the economy into sectors is different: in the national income accounting, transport is part of the service sector. To calculate and compare the energy intensity of the value added of different sectors, we remove the transport sector from the service sector. We find that the energy intensity of the value added of service activities (transport sector excluded) is on average much lower than the energy intensity of other sectors (Fig. 1). Likewise, in France's CO2 emissions accounting (data from CITEPA[8]), the services sector represented only 7% of emissions in 2008.

The idea that services, being non-material, consume less energy and exert less pressure on the environment is a highly attractive one, as it means that the increasing service orientation of an economy, which is the unstinting trend in every developed country, will automatically foster sustainability. This idea has taken hold with governments and is defended by the OECD (2000) and the European Union in its Lisbon Strategy.

We will devote the sections that follow to demonstrating that the non-materiality of services—the presumed basis of their low environmental impact—is a myth and to examining the consequences of such a result in terms of energy consumption.

3. Determining Overlooked Sources of Energy Consumption

We intend to propose a theoretical breakdown of service provision, which reveals the main dimensions of its materiality and therefore its main sources of energy consumption. We distinguish between direct energy consumption, which is that required for and during the provision of services, and indirect energy consumption, which is brought about in the rest of the economy by service activities.

3.1. Breakdown of Service Provision and Direct Energy Consumption

Our theoretical breakdown of service provision is based on a rereading, from an energy viewpoint, of works that focus on the

[1] He specifically mentions the domestic servants, the doctors, the lawyers, the artists, etc.

[2] Heinrich Storch, 1823. *The Course of Political Economy, or an Exposition of the Principles which Determine the Prosperity of Nations*. Cited in Delaunay and Gadrey, 1987.

[3] These activities are classified as services since it is generally acknowledged that their informational content exceeds their physical content (Illeris, 1989). According to the French National Institute of Statistics and Economic Studies (INSEE), printing and the mass production of recordings, for their part, belong in the industrial sector.

[4] The positive definition is distinct from a residual definition, in which services are all the activities which are neither manufacturing nor agricultural activities.

[5] "A service may be defined as a change in the condition of a person, or a good belonging to some economic unit, which is brought about as the result of the activity of some other economic unit, with the prior agreement of the former person or economic unit" (Hill, 1977, p. 318).

[6] Hill (1999) considers that non-materiality is not an exclusive feature of services and that there are also non-material or intangible goods. These include new musical compositions, the text of a new book, a new film, a blueprint for a new artefact, a new software, etc.

[7] INSEE: Institut National de la Statistique et des Etudes Economiques [National Institute of Statistics and Economic Studies].

[8] CITEPA: Centre Interprofessionnel Technique d'Etudes de la Pollution Atmospherique [interprofessional technical center for the study of atmospheric pollution]. Data for 2008 relating to CO2 emissions, excluding LULUCF (Land Use, Land-Use Change and Forestry).